

# The Upper Mississippi River Comprehensive Flood Damage Reduction Study: Taking a Fresh Look at an Old Problem on a Basin-Wide Level

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The Flood of 1993 resulted in catastrophic damages throughout much of the Upper Mississippi River Basin. Forty-seven deaths were attributed to the flood, and flood damages exceeded \$15 billion. About half of the flood damages were related to agricultural losses. Approximately 74,000 people were evacuated, and flooding damaged 72,000 homes. In-place flood damage reduction facilities (levees, etc.) built by the Corp of Engineers prevented an estimated \$19 billion in potential additional damages. While the Flood of 1993 could not be prevented, an integrated system of flood damage reduction (FDR) and floodplain management measures may have further reduced the amount of damages incurred.

The Flood of 1993 and several studies, reports, and ongoing initiatives prompted citizens to push for an Upper Mississippi River Comprehensive Plan (Comp Plan) to integrate existing and potential future projects into a coordinated system for flood damage reduction and floodplain management. Previous studies, including the Galloway Report and Floodplain Management Assessment Study, found that a systemic, integrated approach to flood management is necessary to reduce flood damages. Similarly, floodplain economic and environmental values can be maximized by systemically identifying opportunities for floodplain-compatible economic development and ecosystem restoration, preservation, and enhancement.

## Study Description

The Comprehensive Plan is evaluating an array

of systemic flood damage reduction plans for the Upper Mississippi and Illinois Rivers. Both structural and non-structural flood damage reduction alternatives are being considered. In addition, various other systemic needs related to flood damage reduction, such as floodplain habitat restoration and recreation, will be considered.

The Comprehensive Plan is being developed as a collaborative effort involving three Corps Districts (St. Paul, Rock Island, and St. Louis) and a number of federal and state agencies and organizations. It will identify potential future actions and recommendations for systemic improvements that provide flood damage reduction and associated environmental benefits. A Programmatic Environmental Impact Statement (EIS) will be prepared for any positive report recommendations. Follow-on studies would be needed at specific sites, while site-specific National Environmental Policy Act (NEPA) documentation would be tiered from the Programmatic EIS. The EIS will address the impacts of all proposed actions and will provide a broad informational base for “incorporation by reference” in any subsequent NEPA documents and actions stemming from the Comprehensive Plan.

## Background and Study Area

The study area is the Upper Mississippi River Basin drainage area above Cairo, IL, at the confluence of the Mississippi and Ohio Rivers (exclusive of the Missouri River Basin), and it encompasses a land area of about 185,000 square miles. The Upper Mississippi River Comprehensive

Plan includes both the Upper Mississippi and the Illinois Rivers, a total of about 1,100 river miles.

More specifically, the study area includes the Upper Mississippi River from Upper St. Anthony falls at St. Paul, MN to its confluence with the Ohio River and the Illinois River from Lockport Lock and Dam to its confluence with the Upper Mississippi at Grafton, IL.

The total acreage of the river-floodplain system exceeds 2.6 million acres of aquatic, wetland, forest, urban, grassland, and agricultural habitats. The distribution of leveed floodplain as a proportion of total floodplain area is about:

- 3 percent north of Pool 13;
- 50 percent from Pool 14 through Pool 26;
- 80 percent in the Open River; and
- 60 percent of the lower 160 miles of the Illinois River.

The area includes the metropolitan areas of St. Louis, MO; Davenport, IA; La Crosse, WI; and Minneapolis-St. Paul, MN. There are currently over 140 flood protection systems in place in the Mississippi and Illinois River floodplains protecting urban and agricultural areas. Most of the systems (about 100 total) were federally constructed with the remainder being systems constructed by others. These systems include over 2,200 miles of floodwalls and levees. There are two other general land categories besides urban and agricultural: unprotected urban areas and environmental refuge areas managed by the federal, state or local government.

## Why the UMR Comprehensive Plan

Post-1993 flood reports, the regional summit meetings of the mid-1990s, several subsequent studies, and various stakeholders recognized the lack of, and need for, a comprehensive, systemic plan for flood damage reduction and floodplain management along the Upper Mississippi and Illinois Rivers. This recognition ultimately led to the authorization of the Upper Mississippi River Comprehensive Plan (UMRCP) in the Water Resources Development Act (WRDA) of 1999 (Section 459). The primary purpose of this study is the development of an integrated strategy and implementation plan for flood damage reduction. It

is also intended to address, to a very limited extent, other components of floodplain management, including: continued maintenance and improvement of the navigation project; improved management of nutrients and sediments; environmental stewardship; and recreational opportunities.

Flood damages continue to be incurred throughout the UMRS, and the lack of a systemic flood protection and flood damage reduction plan is negatively affecting all aspects of local and regional floodplain planning, management, and economic development. Opportunities may exist to develop and implement a systemic plan that reduces cumulative flood protection costs and annual flood damages while simultaneously providing long-term improvements to other system values and uses (ecological, recreation, transportation, etc.). Multiple studies have been completed since the flood of 1993. These efforts provide the foundation upon which a more comprehensive conceptual plan for flood protection and flood damage reduction is being developed.

The Comprehensive Plan is using recently updated frequency water surface profiles obtained from the Upper Mississippi, Missouri, and Illinois River Flow Frequency Study for frequency flood events between 50% (2-year) and 0.2% (50-year). This is the first time that an updated frequency analysis has been used for systemic planning and analysis since the Flood of 1993.

Long-term ecosystem management and sustainability planning will benefit from the development of a systemic conceptual plan for flood protection and flood damage reduction. For example, flood damage reduction planning could result in compatible opportunities for the application of conservation easements and ecosystem restoration measures.

## Authority - Plan versus Study

The authority for a typical Corps of Engineers study may read in part “with a view to determining the feasibility of measures for flood control and other purposes.” Plans are not fully developed until a federal interest is determined, which includes initial evaluation of economic, engineering, and environmental feasibility along with potential local sponsor interest. A majority of Corps of Engineers

studies are terminated early in the study phase as they are found deficient during evaluation.

The authority to accomplish the UMRCF is found in Section 459 of Water Resources Development Act (WRDA) 1999. The beginning portion of the authorization follows.

**SEC. 459. UPPER MISSISSIPPI RIVER COMPREHENSIVE PLAN.**

(a) **DEVELOPMENT** —The Secretary shall develop a plan to address water resource and related land resource problems and opportunities in the Upper Mississippi and Illinois River Basins from Cairo, Illinois, to the headwaters of the Mississippi River, in the interest of the systemic flood damage reduction by means of:

- (1) Structural and nonstructural flood control and floodplain management strategies;
- (2) Continued maintenance of the navigation project;
- (3) Management of bank caving and erosion;
- (4) Watershed nutrient and sediment management;
- (5) Habitat management;
- (6) Recreation needs; and
- (7) Other related purposes.

The study authorization directs the development of a systemic, flood damage reduction plan. Traditional Corps of Engineers evaluation techniques are being used including economic, engineering, and environmental analyses. If the economic analysis shows that no plan is economically feasible then, similar to ecosystem restoration projects, the plan will be developed in a cost effective manner and the impacts will be presented in terms of costs, national economic benefits, environmental impacts, and regional economic development.

### **Big “CP” Versus Little “cp”**

Upon initiation of the Comprehensive Plan effort, a significant question was considered about the overall scope of this study: Is this a wide ranging comprehensive watershed study addressing not only the floodplain? Is this the big “CP” study including the entire 185,000 square mile watershed as it impacts the major rivers?

Over a period of several months, with discussions at all levels within the Administration, it was determined that the emphasis needed to be on the *floodplains* of the Mississippi and Illinois Rivers, not the entire watershed. This present phase of the Comp Plan effort is entirely funded by the federal government (i.e., no cost sharing) and there is a three year study limit imposed in the authorization with an opportunity for the identification of follow-on studies. The current study is estimated to cost more than \$5 million. A truly comprehensive watershed study for an area of this geographic scope could cost tens of millions of dollars.

### **Relationship to the Upper Mississippi River - Illinois Waterway System Navigation Study (Nav Study)**

The Upper Mississippi River - Illinois Waterway System Navigation Study, begun in 1993, was originally intended only to determine the feasibility of major navigation efficiency improvements. In the last three years, ecosystem restoration needs related to navigation was added as a study purpose. The study area is essentially the same as for the Comp Plan. How does one insure that the two studies are complimentary?

Several team members are working or have worked, at various times, on both studies. The Comp Plan Project Manager worked on the Nav Study since the feasibility phase began. The two efforts share and use the same information and data to the extent feasible. To fully consider ecosystem restoration, the Nav Study developed restoration objectives for the entire floodplain, bluff to bluff. The ecosystem restoration portion of the Nav Study recommendations addresses a significant portion of the objectives. With some degree of overlap, the Comp Plan is considering the remaining environmental opportunities objectives.

### **Alternative Plans**

The Comp Plan study purpose is to develop a systemic flood damage reduction plan that is comprehensive and to addresses both flood damage reduction and long-term economic and environmental sustainability. Both structural and non-structural measures will be considered in developing the plan.

The Comp Plan is developing systemic plans to work toward satisfying the above goal using the the application of National Economic Development (NED) and then National Ecosystem Restoration (NER) principles. To formulate the plans, a series of considerations have to be determined and understood.

Some basic questions for any plan include the following considerations:

- Are all land use areas protected to the systemic level of protection, urban, agricultural, unprotected and environmental/refuge?
- Are induced flood damages allowed as the flood control systems are raised (confined)?
- Are all levee/system types raised and protected to the systemic level of protection: federal, non-federal and private?
- Will levees/systems higher than the design level be degraded for uniform protection?
- Does the proposed level of protection vary by land use and system type?

Initial alternative plans for flood damage reduction applied to the entire system are as follows:

- Level of protection, 0.2% (500-year), confined, for urban, agricultural and unprotected areas for all types (federal, non-federal and private)
- Level of protection, 0.2% (500-year), unconfined with maximum water surface rise (induced flooding) for 1% (100-year) flood event of 1 foot, for urban, agricultural and unprotected areas for all types
- Unconfined, level of protection, 0.2% for urban areas, 0.5% (200-year) for agricultural areas, for federal and non-federal systems
- Unconfined, level of protection, 0.2% for urban areas, 1% (100-year) for agricultural areas with only 2 feet of freeboard, for federal and non-federal systems
- Unconfined, level of protection, 0.2% for urban areas, 2% (50-year) for all agricultural areas
- Non-structural: relocate unprotected urban areas out of the floodplain

The 0.2% (500-year) confined plan was analyzed first because it was one of the easiest plans to model from a hydraulic standpoint. The induced flood height rise in some areas was in excess of 10 feet, making this plan unrealistic and impossible to implement.

The other plans are unconfined plans designed and configured to allow only a minimal rise no more than 1 foot rise for the 1% (100-year) water surface profile with the plan in place. This is consistent with the National Flood Insurance policy of the Federal Emergency Management Agency of the Department of Homeland Security. If the initial analysis of a plan results in a rise in profile for the 1% flood level greater than 1 foot, then a trial and error process using levee set backs and storage occurs until the best plan configuration is determined.

## Emergency Action Scenarios

A systemic analysis termed the Emergency Action Scenarios are also being conducted. These scenarios can be described using text from a collaborator which reads one alternative that reflects a system wide operational strategy for conveying floodwaters during major flood events. Such an alternative would presumably include such actions as strategic controlled levee overtopping, temporary levee raises, and minor structural modifications to accommodate the operational strategy.

One way to look at this plan would be for state and local governments to ask, "Could we have more effectively used our flood fighting and emergency resources to achieve an even greater reduction in flood damages during 1993 or other flood events?" To consider the technical aspects of the scenarios, a series of four hydraulic and economic options were analyzed to date.

The first option assumed that all urban area systems located in the floodplain of the Upper Mississippi and Illinois Rivers are raised 2 feet using emergency flood fighting techniques. The hydraulics change in water surface profile with the emergency raise assumed in place as well as the economic impact of flood damage reduction are determined. The next analysis assumed, in addition to the raise of all the urban systems, that all existing agricultural levee systems are raised 1 foot by sandbagging or other emergency measures. The third option assumed agricultural systems are raised 2 feet, just as the urban systems are raised 2 feet, and the

resulting hydraulic and economic impacts determined. The final analysis, to date, assumed that both existing urban and agricultural systems are raised a total of 3 feet by emergency techniques. The resulting systemic analysis provides data for resource agencies to consider in a non-emergency framework. With the Emergency Action Scenario analysis, one can compare the hydraulic impacts of proposed actions on water surface profile and the resulting economic damages prevented.

Further analysis may take place after coordination with Comp Plan collaborators.

## Summary

The Upper Mississippi River Comprehensive Plan will develop a systemic flood damage reduction project that is consistent with environmental sustainability goals and responds to the study authorization as per the Water Resources Development Act of 1999 (Public Law 106-53).

## Author Bio and Contact Information

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## Reference

Water Resources Development Act of 1999, 106th Congress, 1st Session (Aug. 17, 1999). Public Law 106-53.